FEBRUARY 2019 Update

Small Cells Forecast

Major changes to the forecast this quarter include:

1. Overall, the small cell market activity hit somewhat of a lull in the second half of 2018 as major indoor deployments in China and North America hit a pause as operators focus on their 5G transition. We believe this is a temporary event, but we have accounted for slower growth in the Carrier Indoor segment as DRS shipments especially in China is expected to grow somewhat gradually rather than an accelerated growth.

2. As a result, the overall Small Cells shipment is expected to grow at 8% CAGR from 2017 to 2023. Excluding the high-volume Residential femtocells, the growth is expected to be 13%. In terms of revenue, the market is expected to reach $3.5B in 2023 growing at 6-7% CAGR.

3. We have slightly upped our Residential femtocell market growing at a low single digit. Relative to other high-power small cell segments, it only represents about 5% of the overall Small Cells market. With more vendors introducing high-power "mini macro" class radios which offer longer range in a small form factor, we forecast the Carrier Outdoor segment to represent the fastest growing segment, growing at over 8% CAGR. The Carrier Indoor segment will remain the largest share of the market representing about $1.7B in 2023.

4. We continue to see Residential femtocells being utilized as a customer retention tool by the operators globally. We have slightly upgraded the growth prospect for these radios especially as we see "MVNO-turned-MNOs" like Rakuten and others look to these inexpensive radios to supplement network capacity where it is needed the most.

5. The Enterprise small cell segment continues to do well (for those who have already received operator approvals in markets where they serve). For smaller enterprise venues where operators are not making a direct investment, operators seem more willing to supplement in-building wireless projects with approved indoor small cells as a signal source.

6. As mentioned above, the pace of Carrier Indoor deployments especially in China has slowed down from a few years ago. As major DRS vendors including Huawei, ZTE, and Ericsson introduce 5G DRS units operating in the 3-4 GHz mid-band in the second half of 2019, we expect the pace of deployment to start to increase in 2020-2023 as the operators look to address the mobile traffic growth indoors where the consumption happens.

7. The Carrier Outdoor segment has been revised up based on strong indications, especially in North America. We expect the CBRS activity to contribute to the growth as operators look to leverage the 3.5 GHz band in concert with their 5G transition plans leveraging the

millimeter wave before the 3.7-4.2 GHz band becomes available (likely in the 2020-2021 timeframe).

8. We see a gradual pace of LAA adoption in N. America and SE Asia. AT&T is making good use of LAA as a part of their "5G Evolution" market deployment, selectively leveraging the unlicensed spectrum to showcase 5G-like speeds. Moreover, we are seeing several operators leveraging LAA with DRS and RRH deployments to increase network capacity.

9. , and AT&T. Sprint is expected to continue its network expansion via small cells and macro site expansion with its abundant treasure trove of 2.5 GHz spectrum. The early LAA results show dramatic user throughput speed increases. We believe operators in other regions will also adopt LAA in the coming years.

10. The Small Cells forecast has been updated to the latest CBRS forecast that was published in November 2018. While we expect commercial deployments to occur in the second half of this year, the meaningful volume of CBRS radio unit shipments won't occur until 2020 and beyond. We are seeing several major vendors with FCC-approved CBRS radios for both indoor and outdoor deployments. So, the commercial reality isn't too far off (thankfully).